(12) UK Patent Application (19) GB (11) 2 256 051 (13) A

(43) Date of A publication 25.11.1992

(21) Application No 9110992.6

(22) Date of filing 21.05.1991

(51) INT CL[5]
G01K 15/00

(52) UK CL (Edition K)
G1N NAHK N1B3 N1D13 N7A1
U1S S1074 S2166

(56) Documents cited
US 3972236 A

(58) Field of search
UK CL (Edition K) G1N NADC NAFB NAHK NAJD
INT CL[5] G01K 7/18 15/00

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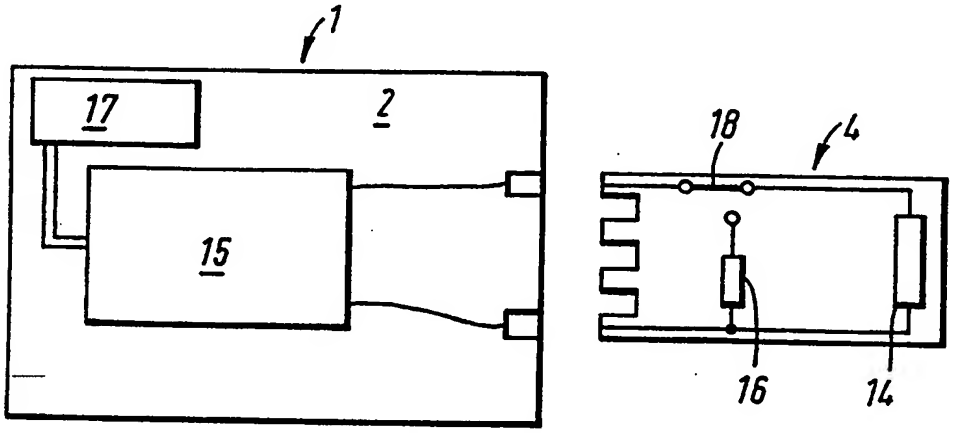
(54) Temperature measuring apparatus

(57) One of a plurality of temperature sensing probes (4) is arranged to be connected to a processing unit (2). Each probe (4) has at least one calibration checking component (16) built in as well as a temperature sensor (14), the or each checking component having a resistance value which is relatively unaffected by temperature and which is equal to the resistance of a properly functioning sensor (14) at a known temperature. The probe (4) can be switched between a temperature sensing mode and a calibration checking mode by a switch (18) either in the probe or in the processing unit. Each of the plurality of probes (4) is arranged to perform a different temperature task and accordingly the calibration checking component (16) of a particular probe is selected so as to have a value which is appropriate to the particular temperature task allocated to that probe. A calibration capsule which can be substituted for a probe and which contains a plurality of checking resistors (16) is also described (Fig. 5 not shown).

FIG. 1



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1990.

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FIG. 1

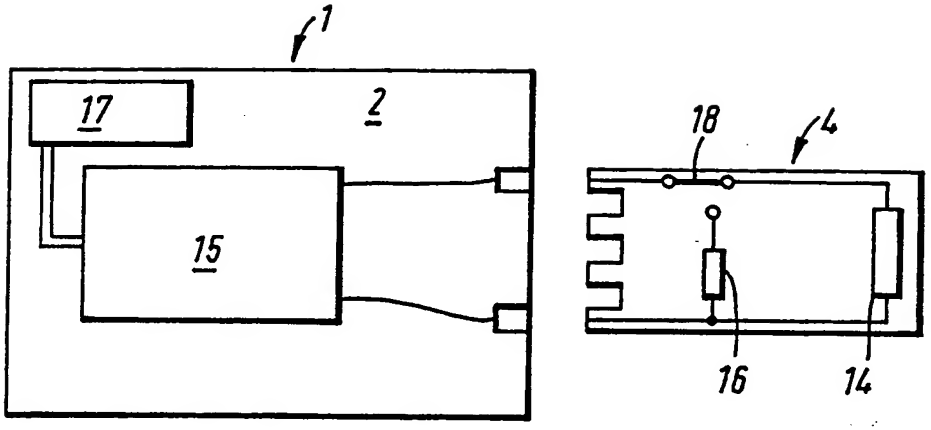


FIG. 2

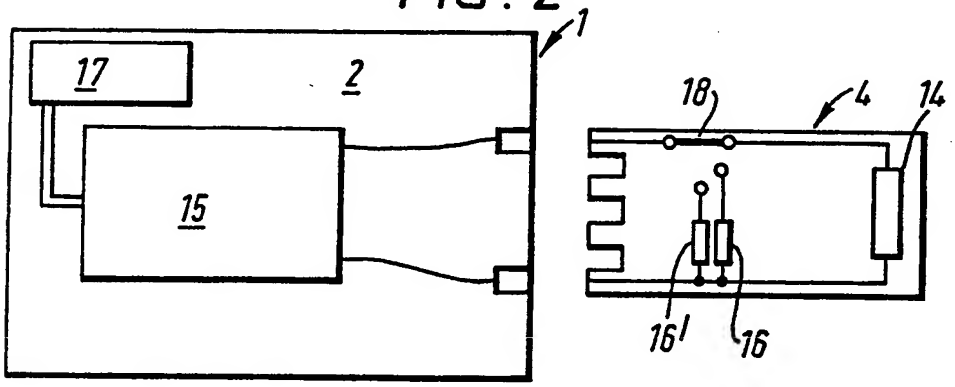


FIG. 3

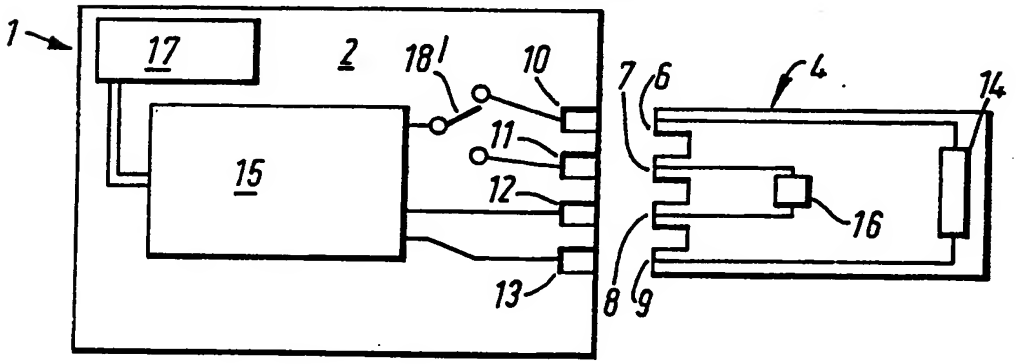


FIG. 4

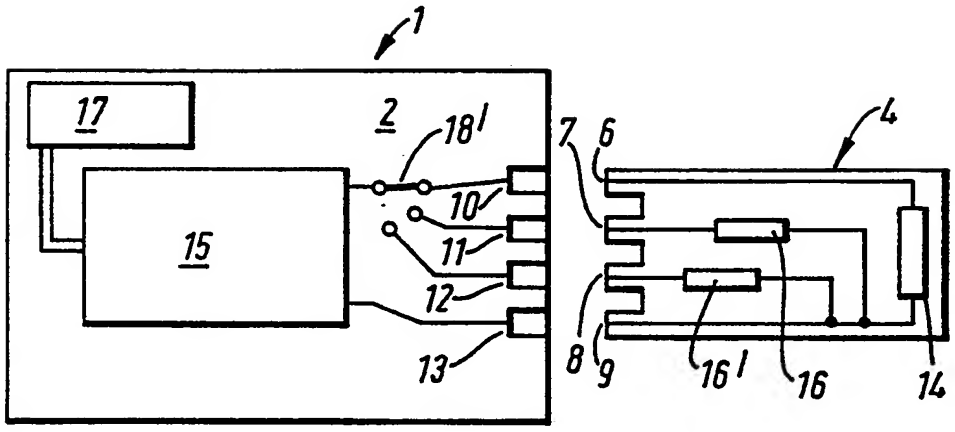
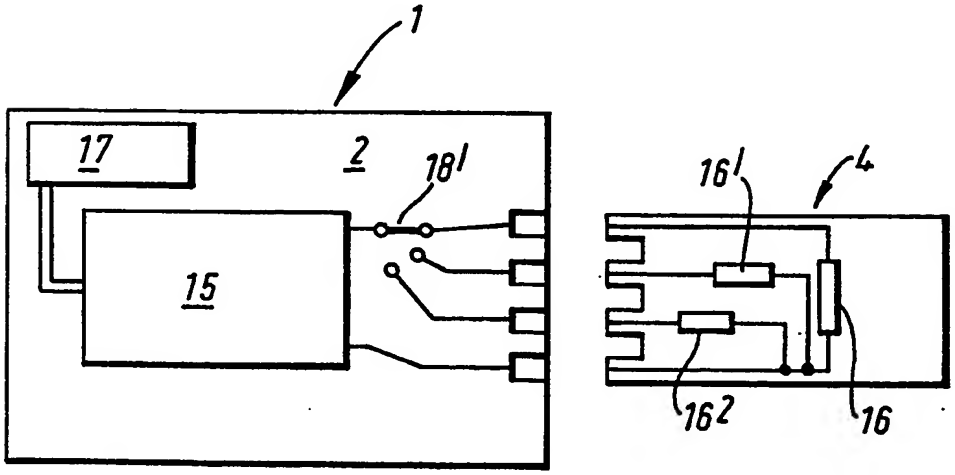


FIG. 5



TEMPERATURE MEASURING APPARATUS

The present invention relates to temperature measuring apparatus and in particular to the calibration thereof.

Thermometers which measure change in electrical resistance with temperature in order to give temperature readings need to be periodically tested for accuracy. This is particularly pertinent in the food industry, where thermometer accuracy needs to be verified at regular intervals, for example at least every three months. In a known hand held digital thermometer, a probe including the temperature sensing element is plugged into a socket of an instrument body which contains circuitry for deriving and displaying the sensed temperature. In order to confirm the accuracy of such a thermometer, the probe is removed and replaced by a test capsule containing a precision resistor corresponding to a given temperature. The reading provided by the thermometer is compared to the given temperature corresponding to the resistance of the precision resistor. If the two temperatures are the same within predetermined tolerances, then the thermometer is functioning correctly. If not the thermometer needs to be recalibrated.

In one known system, a series of different temperature probes are used for different purposes. To avoid contamination between different foods, there may be specific probes for cooked food, raw meat, frozen food and vegetables. These may be intended for use in different temperature operating ranges, for example as in the case of frozen food, raw meat and vegetables. The probes may be optimised for use in particular temperature ranges. In this known system the probes are colour coded.

A series of test capsules will generally be required, corresponding to the different temperature ranges in which the measuring device is intended to operate. These might for example be set to +3°C, and -18°C for chilled and frozen food respectively. There is a certain amount of inconvenience in having to keep such a series of test capsules.

It is an object of certain embodiments of the invention to provide a temperature measuring device the calibration of which can be conveniently checked.

Viewed from one aspect, there is provided a probe for a temperature measuring device, said probe having a sensor whose resistance changes with temperature over a normal temperature operating range of the probe, to enable temperature measurements to be carried out by the device, and said probe further having a calibration check component whose resistance corresponds to the resistance of the sensor at a predetermined temperature within the normal operating range of the probe, the resistance of the calibration check component being constant in an ambient temperature range in which calibration checking is to be carried out, and connecting means being provided for electrically connecting the sensor and the calibration component to the temperature measuring device.

Thus, once a probe is connected to the device, it becomes possible to carry out a calibration check without removing the probe and without having to select separately an appropriate test capsule for the temperature concerned. Thus a more regular and convenient checking of the temperature measuring device is possible as compared with the prior art.

In use, switching means will be provided to switch between the sensor and the calibration check component. These switching means could be within the probe itself, which is of particular use if the probe is to be used with existing equipment since no changes need to be made

to the connecting means or circuitry of the device. In this case, the connecting means would only handle either the sensor or the calibration check component at any particular time. Alternatively, the connecting means could be such as to cope with both the sensor and calibration check components simultaneously e.g. being in the form of a plug with sufficient pins or sockets. In such a case, the switching means would be provided in the device itself.

Preferably, the device has means for indicating when calibration checking is being carried out. This may be associated with temperature display means. For example the display may flash or include an appropriate legend during calibration checking. Where the device is provided with internal switching between the outputs from the sensor and the calibration check component, this can serve also to indicate which mode is in operation.

Several different probes may be provided which can be coupled to the same temperature measuring device. As in the prior art, each probe can be used for different purposes for example to avoid contamination between cooked and raw food. In such probes, the calibration check component will be chosen so as to correspond to a temperature which is within the normal operating range of that particular probe. For example if one probe is to measure the temperature of frozen foods whilst another is to measure the temperature of chilled food, the resistance of the calibration component of the first probe could correspond to a temperature of -18°C whilst that of the second probe could correspond to a temperature of +3°C. Thus the resistance of the calibration component can be chosen so as to be appropriate to the particular operating range of a probe.

In one embodiment of the invention, more than one calibration checking component can be provided in the

probe so that if the probe is to be used over a wide range of temperatures, the accuracy can be verified at two or more temperatures in that range using more than one calibration checking component. The switching means can be arranged to switch between the sensor and each of the calibration checking components. Indicating means may then be provided for indicating not only when the calibration is being checked but also at what temperature.

Preferably the sensor is in the form of a thermistor (semiconductor sensor) or platinum resistance thermometer.

Of course a probe containing both the temperature sensor and a calibration component can be used with a temperature measuring device having its own built in calibration check component. There will then be a choice of a general calibration check by the device or a specific check by the probe itself. The probe need not be used in a calibration mode at all.

Protection is also sought for the combination of a probe with a suitable processing unit and thus viewed from another aspect there is provided temperature measuring apparatus comprising a processing unit, a temperature probe, and connection means for connecting said processing unit to the temperature probe so that said processing unit is able to receive information provided by said probe, wherein said probe comprises a sensor whose resistance changes with temperature over a normal operating range of the probe to enable temperature measurements to be carried out by said device, and a calibration check component whose resistance corresponds to the resistance of the sensor at a predetermined temperature within the normal operating mode of the probe, the resistance of the calibration check component being constant in an ambient temperature range in which calibration checking is to be carried out, and the apparatus further comprising

switching means for selectively providing the processing unit with information from the sensor and the calibration check component.

The switching means can be provided in the housing or in the probe.

A processing unit for use with a probe in the manner described above, itself has novel and inventive features and thus viewed from another aspect there is provided a temperature measuring instrument comprising a processing unit having connection means for connection with a temperature probe, said connection means being arranged to receive a plurality of different signals from the probe, each signal providing respective information and said instrument further comprising switching means for selectively coupling the processing unit with one of said plurality of different signals whereby the processing unit is able to process the information provided by said one signal so as to calculate a temperature.

In use, a probe to be connected to the instrument will comprise a temperature sensor and a calibration component. Thus the plurality of different signals correspond to firstly actual temperature values and secondly a calibration checking temperature value.

Instead of being used with a probe, the instrument may from time to time be used with a calibration capsule having a number of calibration check components corresponding to a number of predetermined temperatures, and no temperature sensor. The calibration check components have different resistances which respectively correspond to predetermined temperatures within the normal operating range of the instrument. Thus the calibration at a number of different temperatures can be checked using only a single capsule.

In one embodiment of a probe for use with the instrument, a calibration checking component and a temperature sensor are provided with separate

connections with the instrument. Thus, e.g. a plug to interconnect the probe and the instrument could have one or more pins for the temperature sensor and one or more separate pins for the calibration component. In such a case, the switching means will be arranged to switch between the inputs. Alternatively the signals from a temperature sensor and calibration component could be received at the housing via the same inputs and be distinguished by codes imposed on the signals.

Embodiments of the invention will now be described by way of example and with reference to the accompanying drawings in which:

Figure 1 shows a schematic diagram of a first embodiment of the invention;

Figure 2 shows a schematic diagram of a second embodiment of the invention;

Figure 3 shows a schematic diagram of a third embodiment of the invention;

Figure 4 shows a schematic diagram of a fourth embodiment of the invention; and

Figure 5 shows a schematic diagram of a fifth embodiment of the invention.

Figure 1 shows temperature measuring device 1 having a main instrument housing 2 and a probe 4. The probe 4 has four pins 6,7,8,9 which are received in respective sockets 10,11,12,13 in the housing 2 and a temperature sensor 14 for sensing temperature. The housing 2 has circuitry 15 which is electrically coupled to the temperature sensor 14 for deriving the temperature sensed and a display 17 for displaying the temperature and indicating whether the thermometer is in measuring or calibration checking mode. The temperature sensor 14 is of the type which senses temperature by changes in the resistance in response to temperature changes and may be a thermistor or platinum resistance thermometer. A precision resistor 16 is arranged in the probe along with a switch 18. The probe incorporates

four plugs for insertion into respective sockets in the main instrument housing. However only two sockets and pins are actually used in this embodiment. Accordingly the other sockets and pins may be omitted. The switch 18 is such that either the circuit from the precision resistor 16 to the circuitry 15 or the circuit from the temperature sensor 14 to the circuitry 15 is completed dependent on whether the device is in calibration checking mode or temperature measuring mode so that either the temperature sensor or precision resistor is connected to the circuitry.

The operation of the device will now be described. When the device is in temperature measuring mode, the precision resistor 16 is short circuited and a voltage is connected across the temperature sensor 14. The value of the current passing through the sensor 14 is sensed by the circuitry 15. Thus the resistance and hence measured temperature of the sensor 14 can be derived. The measured temperature is measured and displayed along with an indication that the temperature is a measured value. This can be indicated by a legend in a corner of the display or by the whole display flashing.

To change to calibration checking mode the switch is moved so as to short circuit the sensor and connect in the precision resistor 16. The circuitry 15 derives the temperature corresponding to the resistance of the precision resistor 16. The derived temperature is displayed along with an indication that the device is in calibration checking mode. Thus the derived temperature can be compared with the temperature to which the resistance of the precision resistor corresponds. If the two temperature are the same to within predetermined tolerances then the temperature measuring device is correctly calibrated. If not the device needs recalibration. Alternatively the circuitry can be arranged to display the difference between the measured

value and the displayed value or just a general "error" indication.

The circuitry is able to determine whether the device is in temperature measuring mode or in calibration mode by detecting a signal generated by the switch 18 and accordingly provide an indication if necessary for the display. Of course the indication as to what mode the device is in may be provided by the position of the switch.

A second embodiment is shown in Figure 2. The device is generally the same as that of Figure 1 apart from the addition of another precision resistor 16' in the probe. In this embodiment the calibration of the device can be checked at two different temperatures. The device operates in the same manner as above apart from the switch 18 is able to switch between each of the three sets of inputs.

In another embodiment of the device shown in Figure 3, the device is the same as shown in Figure 1 apart from the switch 18' being in the housing rather than in the probe. Like parts are identified by like reference numerals. Thus, two signals are provided by a probe via the sockets, one corresponding to the sensor signal via sockets 10 and 13 and one corresponding to the calibration checking means via sockets 11 and 12. The switch is arranged so as to selectively connect one of the signals to the circuitry depending on whether the device is in temperature measuring mode or in calibration checking mode. The switch thus short-circuits the signal which is not required.

Figure 4 shows a modification to the device of Figure 3. The device has two precision resistors which along with the sensor 14 share a common input pin 9. The switch 18' is aranged to switch between the signals provided via sockets 10, 11 and 12.

Where a device is to be used to measure the temperature of food it is preferably to have a number of

probes so as to avoid contamination. Thus there could be one probe for cooked food, one for frozen and chilled foods, one for raw meat and another for vegetables. In each case the temperature range to be measured by each probe differ slightly. Thus the resistance value of the precision resistors will be chosen in accordance with the temperature measuring task of a particular probe. For example if a probe us to be used exclusively to measure the temperature of frozen food, then the resistance of the precision resistor should be chosen so that it corresponds to a temperature in the range of that of chilled food. If the device has more than one precision resistor, then the values can be chosen so as to check the device at a range of temperatures throughout the operational range of the probe.

With a device such as shown in Figure 1, 2, 3 or 4 a calibration capsule containing more than one precision resistor and no temperature sensor can be used. Such an embodiment is shown in Figure 5. The switch, which is arranged in the housing is arranged to switch between the respective resistors. Thus only one calibration test capsule is required to check the calibration over a range of temperatures.

There are of course more complex ways of achieving the switching. In one such embodiment the circuitry is able to determine whether the device is in temperature measuring mode or calibration checking mode as the switch is arranged to send a signal to the circuitry when moved. When the switch is moved to a first position, the switch provides a signal which latches the circuitry and causes it to indicate if necessary the mode the device is in.

When the switch is moved to the second position, the switch generates a second signal which causes the latching to be removed and causes an indication to be produced that the device is in changed mode. In such embodiments, the switching means may be provided on the

probe and the probe only requires a single set of input pins for connection to the circuitry.

In another variation in which the switching means are provided in the housing, the switch is able to identify which signal is required as a suitable code is imposed on the calibration check component signal and/or sensor signal in the probe. Thus only a single set of inputs are required. Such instruments may be suited to situations where a number of calibration check components are included in the probe.

Claims

1. A probe for a temperature measuring device, said probe having a sensor whose resistance changes with temperature over a normal temperature operating range of the probe, to enable temperature measurements to be carried out by the device, and said probe further having a calibration check component whose resistance corresponds to the resistance of the sensor at a predetermined temperature within the normal operating range of the probe, the resistance of the calibration check component being constant in an ambient temperature range in which calibration checking is to be carried out, and connecting means being provided for electrically connecting the sensor and the calibration component to the temperature measuring device.

2. A probe as claimed in claim 1, wherein switching means are provided in said probe to switch between said sensor and the calibration check component.

3. A probe as claimed in any preceding claim, wherein said sensor is in the form of a thermistor or platinum resistance thermometer.

4. A probe as claimed in any preceding claim, wherein a plurality of different calibration checking components are provided in said probe to check calibration in respect of different temperatures.

5. A set of probes comprising a plurality of probes as claimed in any one of claims 1 to 4, wherein each probe is connectable to said processing unit and each of said probes is suitable for a different temperature task, wherein the calibration check component of each probe is selected in dependence on the temperature task of the probe.

6. Temperature measuring apparatus comprising a processing unit, a temperature probe, and connection means for connecting said processing unit to the temperature probe so that said processing unit is able to receive information provided by said probe, wherein said probe comprises a sensor whose resistance changes with temperature over a normal operating range of the probe to enable temperature measurements to be carried out by said device, and a calibration check component whose resistance corresponds to the resistance of the sensor at a predetermined temperature within the normal operating mode of the probe, the resistance of the calibration check component being constant in an ambient temperature range in which calibration checking is to be carried out, and the apparatus further comprising switching means for selectively providing the processing unit with information from the sensor and the calibration check component.

7. Temperature measuring apparatus as claimed in claim 6, comprising means for indicating that calibration checking is being carried out.

8. Temperature measuring apparatus as claimed in claim 7, wherein said probe comprises a plurality of different calibration check components to check calibration in respect of different temperatures and said indicating means is arranged to indicate the temperature for which the calibration checking is being carried out.

9. A temperature measuring apparatus comprising a processing unit having connection means for connection with a temperature probe, said connection means being arranged to receive a plurality of different signals from the probe, each signal providing respective information and said instrument further comprising switching means for selectively coupling the processing

unit with one of said plurality of different signals whereby the processing unit is able to process the information provided by said one signal so as to calculate a temperature.

10. Temperature measuring apparatus as claimed in any of claims 6 to 9, wherein a calibration capsule is arranged to be coupled to said connection means, said capsule having a plurality of calibration check components corresponding to a plurality of predetermined temperatures whereby calibration at a number of different temperatures can be checked.

11. Temperature measuring apparatus as claimed in any of claims 6 to 10, wherein signals from at least one temperature sensor and at least one calibration component are arranged to be received at said processing unit at the same inputs and said signals are distinguishable by said unit by means of codes imposed on the signals.

12. Temperature measuring apparatus as claimed in any one of claims 6 to 10, wherein signals from at least one temperature sensor and at least one calibration component are arranged to be received at said processing unit at respective different inputs.

13. A temperature apparatus, a probe or a processing unit substantially as hereinbefore described with reference to Figures 1, 2, 3, 4 or 5.

Patents Act 1977 14
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number

GB 9110992.6

Relevant Technical fields

(i) UK Cl (Edition K) G1N (NADC, NAFB, NAHK, NAJD)

(ii) Int Cl (Edition 5) G01K 7/18, 15/00

Search Examiner

M G CLARKE

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search

17 AUGUST 1992

Documents considered relevant following a search in respect of claims 1 TO 13

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
A	US 3972236 (ASS. TO AMERICAN MEDICAL ELECTRONICS CORPN) - whole document	6, 9

Category	Identity of document and relevant passages	Relevant to claim(s)

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